EXHIBIT 15

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

FUJITSU NETWORK COMMUNICATIONS, INC.
Petitioner

v.

CAPELLA PHOTONICS, INC.
Patent Owner

Inter Partes Review Case No. IPR2015-00726
Patent No. RE42,368

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. RE42,368 UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. §§ 42.1-.80, 42.100-.123

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I. INTRODUCTION

Petitioner Fujitsu Network Communications, Inc. ("FNC" or "Petitioner") requests *inter partes* review of claims 1-6, 9-12, and 15-22 ("Petitioned Claims") of U.S. Patent No. RE42,368 ("the '368 patent") (Ex. 1001), assigned on its face to Capella Photonics, Inc. ("Capella").

This Petition relies on two primary references: U.S. Patent No. 6,798,941 ("Smith") (Ex. 1009) and U.S. Patent No. 6,498,872 ("Bouevitch") (Ex. 1002).

Smith, which was not before the Patent Office, renders all of the Petitioned Claims anticipated or obvious in combination with U.S. Patent Publication No. 2002/0081070 ("Tew") (Ex. 1007). Notably, Smith discloses the precise features that Capella relied upon to distinguish over the prior art it identified in its reissue application.

Bouevitch was before the Patent Office during the reissue prosecution, but Capella admitted that its original claims were overbroad and invalid over Bouevitch in view of one or more of three additional references. Although Capella amended its claims to purportedly overcome their deficiency, the amended claims fail to distinguish over the prior art references identified herein as Bouevitch in combination with U.S. Patent No. 6,442,307 ("Carr") (Ex. 1005) or U.S. Patent No. 6,625,340 ("Sparks") (Ex. 1006) and optionally Tew render all of the Petitioned Claims obvious.

The Petitioned Claims are currently being challenged in view of the combination of Bouevitch and Smith in IPR2014-01166. This Petition presents different grounds and prior art references than those addressed in that challenge.

Inter partes review of the Petitioned Claims should be instituted because this petition shows that there is a reasonable likelihood that Petitioner will prevail on the Petitioned Claims. Each limitation of each Petitioned Claim is disclosed by and/or obvious to a person having ordinary skill in the art ("PHOSITA") in light of the prior art discussed herein. Claims 1-6, 9-12, and 15-22 of the '368 patent should be found unpatentable and canceled.

II. MANDATORY NOTICES AND FEES

Real Parties-in-Interest: Petitioner Fujitsu Network Communications, Inc. and Fujitsu Limited are the real parties-in-interest in this petition.

Related Matters: Capella has asserted the '368 patent in the following actions: *Capella Photonics, Inc. v. Cisco Systems, Inc.*, No. 3:14-cv-03348; *Capella Photonics, Inc. v. Fujitsu Network Communications, Inc.*, No. 3:14-cv-03349; *Capella Photonics, Inc. v. Tellabs Operations, Inc.*, No. 3:14-cv-03350; *Capella Photonics, Inc. v. Ciena Corporation*, No. 3:14-cv-03351 (collectively, "Capella Litigation"). Claims 1-6, 9-12, and 15-22 of the '368 patent are asserted in the Capella Litigation. Petitioner is also filing a petition for *inter partes* review against U.S. Patent No. RE42,678, which is the other patent asserted in the Capella

Litigation and is related to the '368 patent. *Inter partes* review No. 2014-01166 is directed to the '368 Patent, and *inter partes* review No. 2014–01276 is directed to U.S. Patent No. RE42,678.

Counsel: Lead counsel in this case is Christopher E. Chalsen (PTO Reg. No. 30,936); backup counsel is Lawrence T. Kass (PTO Reg. No. 40,671), Nathaniel T. Browand (PTO Reg. No. 59,683) and Suraj K. Balusu (PTO Reg. No. 65,519). A power of attorney accompanies this Petition.

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Payment: Under 37 C.F.R § 42.103(a), the Office is authorized to charge the fee set forth in 37 C.F.R. § 42.15(a) to Deposit Account No. 133250 as well as any additional fees that might be due in connection with this Petition.

III. CERTIFICATION OF GROUNDS FOR STANDING

Petitioner certifies under 37 C.F.R § 42.104(a) that the patent for which

review is sought is available for *inter partes* review and that Petitioner is not barred or estopped from requesting an *inter partes* review challenging the patent claims on the grounds identified in this Petition.

IV. <u>BACKGROUND</u>

<u>Summary</u>: Fiber-optic communication uses light to carry information over optical fibers. Originally, fiber-optic systems used one data channel per fiber. To increase the number of channels carried by a single fiber, wavelength division multiplexing ("WDM") was developed. WDM is a type of optical communication that uses different wavelengths of light to carry different channels of data. WDM combines (multiplexes) multiple individual channels onto a single fiber of an optical network. WDM was known before the '368 patent's priority date. *E.g.*, Ex. 1002 at 1:18-21.

At different points in a fiber network, some of the individual channels may be dropped from the fiber, for example when those channels are directed locally and need not be passed further down the fiber network. At these network points, other channels may also be added into the fiber for transmission onward to other portions of the network. To handle this add/drop process, optical add-drop multiplexers (OADMs) were developed. OADMs are used to insert channels onto, pass along, and drop channels from an optical fiber without disrupting the overall traffic flow on the fiber. Ex. 1001 at 1:51-58. OADMs were known before the

'368 patent's priority date. *E.g.*, Ex. 1002 at 1:25-30.

Configurable OADMs ("COADMS") and reconfigurable OADMs ("ROADMs") are controllable to dynamically select which wavelengths to add, drop, or pass through. *E.g.,* Ex. 1004 at 904-05. These types of devices were known in the art prior to the '368 patent's priority date. *E.g., id.;* Ex. 1002 at Abstract, 5:15-20.

ROADMs operate by separating an input light beam (comprised of multiple wavelengths) into constituent beams called channels. Each of these channels is comprised of a wavelength or range of wavelengths from the input light beam, and is individually routed by a beam-steering system to a chosen output port of the ROADM. For example, a first channel can be steered so that it is switched from an "input" port to an "output" port. Channels switched to the "output" port are passed along the network. At the same time, a second channel can be switched to a "drop" port and removed from the main fiber. The ROADM could also add a new channel to the main fiber through the "add" port to replace the dropped channel. These add/drop techniques were known prior to the '368 patent's priority date. *E.g.,* Ex. 1004 at 904-05; Ex. 1002 at 14:14-15:18.

In addition to routing channels, ROADMs may also be used to control the power of the individual channels. Power control which may be referred to as attenuation is often performed by steering individual beams slightly away from the

target port such that the misalignment reduces the amount of the channel's power that enters the port. Power control (i.e., attenuation) by intentional misalignment in add/drop switches was known prior to the '368 priority date. *See, e.g.*, U.S. Patent No. 6,442,307 ("Carr") (Ex. 1005) at 11:13-33.

ROADMs use wavelength selective routers (WSRs), also called wavelength selective switches (WSSs), to perform switching and power control. *See, e.g.*, *id.* at 11:13-20; U.S. Patent No. 6,625,340 ("Sparks") (Ex. 1006) at Fig. 2b, 5:4-11. As of the '368 patent's priority date, WSRs/WSSs were known. *See, e.g.,* Ex. 1002 at 14:52-65; Ex. 1004 at 904-05; Ex 1005 at 11:26-33; Ex. 1006 at claim 1.

Different technology may be used to perform the switching and attenuation functions in WSSs. In one embodiment, WSSs may use small tilting mirrors, called Micro Electro Mechanical Systems (MEMS) mirrors, which can control the direction of light beams. Ex. 1005 at 1:13-38; *see also* Ex. 1001 at 3:54-58. Prior-art WSSs could tilt the individual mirrors using analog voltage control. Ex. 1005 at 1:13-38; Ex. 1007 at [0030] & [0031]; Ex. 1008 at 9:10-10:3. The orientation of the MEMS mirrors allows each reflected beam to be directed towards a selected port. *Id.* Prior-art MEMS mirrors could be tilted in one or two axes. *Id.*

Cited Art: Except for Bouevitch, none of the references listed in Section VII were cited on the face of the '368 patent.

Reissue Prosecution and Overview of the Claims: The '368 patent originally

issued as U.S. Patent No. 6,879,750 ("the '750 patent"). According to Capella, the original patent's claims were invalid over Bouevitch and in further view of three additional references. Capella expressly acknowledged its error and identified the two elements that it alleged needed to be added to its claims to support patentability, namely (1) control in two-dimensions, and (2) use of beam-deflecting elements for power control:

> ***At least one error upon which reissue is based is described as follows: Claim 1 is deemed to be too broad and invalid in view of U.S. Patent No. 6,498,872 to Bouevitch*** and further in view of one or more of U.S. Patent No. 6,567,574 to Ma [Ex. 1019], U.S. Patent No. 6,256,430 to Jin [Ex. 1020], or U.S. Patent No. 6,631,222 to Wagener [Ex. 1021] ***by failing to include limitations regarding the spatial array of beam deflecting elements being individually and continuously controllable in two dimensions to control the power of the spectral channels*** reflected to selected output ports, as indicated by the amendments to Claim 1 in the Preliminary Amendment.

Ex. 1003 at 81-82 (emphases added).

In its efforts to distinguish over Bouevitch, Capella's first amendment specified that the beam-deflecting elements must be controllable in two dimensions. This amendment corresponds to a mirror tilting in two axes rather than one. As for the second amendment, Patent Owner specified that the beam-

deflecting elements are used to control the power of the channel reflected to a port. Capella made almost identical amendments to each of the independent claims.

V. CLAIM CONSTRUCTION

This Petition shows that the Petitioned Claims of the '368 patent (Ex. 1001) are unpatentable when the claims are given their broadest reasonable interpretation in light of the specification, which is further supported by patentee's allegations in the co-pending litigation.

The Board previously concluded that no express construction was necessary for the claim terms "in two dimensions," "continuously controllable," and "servo-control assembly," among other terms. IPR2014-01166, Paper No. 8 at 11-12. Petitioner agrees that no express construction is required for purposes of this *inter partes* review but offers the constructions set forth below only for purposes of this *inter partes* review to the extent that the Board finds that an express construction is required. The challenges presented herein do not change based on whether there are no express constructions or the constructions set forth below are adopted.

A. "In two dimensions" (all claims)

In the Capella Litigation, Capella asserted that "in two dimensions" should be given its plain and ordinary meaning or construed to mean "in two dimensions (e.g., x and y dimensions)." Ex. 1012 at 15, Joint Claim Construction and Prehearing Statement. Petitioner disagrees with Capella's position. In the Capella Litigation, FNC proposed that "in two dimensions" means "in two axes." *Id.*

The broadest reasonable interpretation ("BRI") for the phrase "in two dimensions" in light of the specification is "in two axes." As claim 1 states the "beam-deflecting elements" are "controllable in two dimensions." The '368 patent consistently describes these beam-deflecting elements as various types of mirrors which are rotated around the two axes in which the mirrors tilt to deflect light. The specification states, for example, that the beam-deflecting elements "may be pivoted about one or two axes." Ex. 1001 at 4:25-26, 9:8-9. The specification also describes certain embodiments that use two-dimensional arrays of input and output ports. For these embodiments, the specification describes that the mirrors are required to tilt along two axes ("biaxially") to switch the beams between the ports. *Id.* at 4:25-29. And further, the '368 patent explains how to control power by tilting the mirrors in two axes. *Id.* at 4:45-56, 11:5-36.

B. "Continuously controllable"/"Controlling … continuously" (all claims)

In the Capella Litigation, Capella asserted that "continuously" should be given its plain and ordinary meaning or construed to mean "actively." Ex. 1012 at 10. Petitioner disagrees with Capella's position. In the Capella Litigation, FNC proposed that "continuously controllable" should be construed as "by analog and not step-wise control." *Id.*

The BRI for "continuously controllable"/"controlling … continuously" in light of the specification is "under analog control." This definition is consistent

with the use of the term in the specification, which describes how "analog" means are used to effect continuous control of the mirrors. The patent explains that "[a] distinct feature of the channel micromirrors in the present invention, in contrast to those used in the prior art, is that the motion…of each channel micromirror is under ***analog control*** such that its pivoting angle can be ***continuously adjusted***." Ex. 1001 at 4:7-11 (emphasis added). Another passage in the specification states that "[w]hat is important is that the pivoting (or rotational) motion of each channel micromirror be individually ***controllable in an analog manner, whereby the pivoting angle can be continuously adjusted*** so as to enable the channel micromirror to scan a spectral channel across all possible output ports." *Id.* at 9:9-14 (emphasis added). Yet another passage states that "channel micromirrors 103 are individually controllable and movable, e.g., pivotable (or rotatable) under analog (or continuous) control." *Id.* at 7:6-8.

C. "Beam-deflecting elements" (all claims)

In the Capella Litigation, Capella asserted that the term "beam-deflecting elements" should be given its plain and ordinary meaning or construed to mean "components of a switching array that can be controlled to cause a change in the path of a light beam." Ex. 1012 at 38-39. Petitioner disagrees with Capella's position. In the Capella Litigation, FNC proposed that the term "beam-deflecting elements" is indefinite, or alternatively should be construed under § 112(6), or

alternatively should be construed to mean "moveable mirrors." *Id.*

The BRI for the term "beam-deflecting elements" in light of the specification is "moveable mirrors." This definition is consistent with the use of the term in the specification, which describes "micromachined mirrors" and "reflective ribbons (or membranes)" as types of beam-deflecting elements. Ex. 1001 at 4:22-25. Specifically, the '368 patent states that the "channel micromirrors may be provided by ***silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam-deflecting elements known in the art***. And each micromirror may be pivoted about one or two axes." *Id.* at 9:5-9 (emphasis added). As additional support for this construction, claims 13 and 14 of the '368 patent respectively state that beam-deflecting elements comprise "micromachined mirrors" and "reflective membranes." *Id.* at 15:1-4. The specification also explains that "[w]hat is important is that the pivoting (or rotational) motion of each channel micromirror be individually controllable in an analog manner, whereby the pivoting angle can be continuously adjusted so as to enable the channel micro-mirror to scan a spectral channel across all possible output ports." *Id.* at 9:9-14.

D. "Servo-control assembly" (Claims 3 & 4)

In the Capella Litigation, Capella asserted that "servo-control assembly" should be given its plain and ordinary meaning or construed to mean "assembly that controls a device in response to a control signal." Ex. 1012 at 93. Petitioner

disagrees with Capella's position. In the Capella Litigation, FNC proposed that "servo-control assembly" should be construed as "assembly that automatically takes measurements, and controls a mechanical device on response to those measurements." *Id.*

The BRI for the term "servo control assembly" in light of the specification is "assembly that uses automatic feedback to control a device in response to a control signal." This definition is consistent with the use of the term in the specification, which equates servo control with use of an automatic feedback loop. For example, when describing its "servo control," the '368 patent teaches a spectral monitor that provides "feedback" control for the mirrors. Ex. 1001 at 11:21-24. The '368 patent states that "servo-control assembly 440 further includes a processing unit 470, in communication with the spectral monitor 460 and the channel micromirrors 430 of the WSR apparatus 410. The processing unit 470 uses the power measurements from the spectral monitor 460 ***to provide feedback control*** of the channel micromirrors 430." *Id.* at 11:18-24 (emphasis added). In another passage, the '368 patent states that the servo-control assembly "serves to monitor the power levels of the spectral channels coupled into the output ports and further provide control of the channel micro mirrors on an individual basis, so as to maintain a predetermined coupling efficiency of each spectral channel." *Id.* at 4:45-52; *see also id.* at 11:24-36.

Moreover, the '368 patent figures depicting the "servo-control assembly," show a controller which takes measurements of the output power and moves the mirrors to further adjust that power—a typical feedback loop. *Id.* at Figs. 4a, 4b. Also confirming this BRI, the feedback-based control described in the '368 patent achieves the same goals that the patent ascribes to its "servo-control assembly"—automatic adjustment to account for changing conditions, such as the possible changes in alignment of the parts within the device. Ex. 1001 at 4:56-67. Extrinsic evidence confirms that a servo involves an automatic feedback. Ex. 1013 at 617, Newton's Telecom Dictionary (17th ed. 2001); Ex. 1014 at 908, Fiber Optics Standard Dictionary (3rd ed. 1997); Ex. 1015 at 1227, Webster's New World College Dictionary (3rd ed. 1997).

VI. LEVEL OF ORDINARY SKILL IN THE ART

The level of ordinary skill in the art is evidenced by the references. *See In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). A PHOSITA at the time of the '368 patent would have been an engineer or physicist with at least a Master's degree, or equivalent experience, in optics, physics, electrical engineering, or a related field, and at least three years of additional experience designing, constructing, and/or testing optical systems. Ex. 1016 at ¶¶ 60-62, Drabik Decl.

VII. OVERVIEW OF CHALLENGE AND RELIEF REQUESTED

Under 37 C.F.R §§ 42.22(a)(1) and 42.104(b)(1)-(2), Petitioner challenges

claims 1-6, 9-12, and 15-22 of the '368 patent. Petitioner requests this relief in view of the following references:

Exhibit	Description	Filing Date	Type of Prior Art
Ex. 1009	U.S. Patent No. 6,798,941 to Smith et al. ("Smith")	September 20, 2001 – Prior art date of September 22, 2000	§ 102(e) (Pre-AIA)
Ex. 1002	U.S. Patent No. 6,498,872 to Bouevitch et al. ("Bouevitch")	December 5, 2000	§ 102(e) (Pre-AIA)
Ex. 1005	U.S. Patent No. 6,442,307 to Carr et al. ("Carr")	November 3, 2000	§ 102(e) (Pre-AIA)
Ex. 1006	U.S. Patent No. 6,625,340 to Sparks et al. ("Sparks")	December 29, 1999	§ 102(e) (Pre-AIA)
Ex. 1007	U.S. Patent Application Publication No. 2002/0081070 to Tew ("Tew")	November 13, 2001 - Prior art date of November 30, 2000	§ 102(e) (Pre-AIA)

A full list of exhibits relied on in this petition is included as Attachment B.

A. Summary of Grounds for Challenge

Inter partes review is requested on the grounds for unpatentability listed in the index below. In support of the proposed grounds for unpatentability, this Petition is accompanied by a declaration of a technical expert, Dr. Timothy Drabik (Ex. 1016), which explains what the art would have conveyed to a PHOSITA.

Ground	35 USC	Index of References	Claims
1	§ 102	Smith	1-6, 9-12 and 15-22
2	§ 103	Bouevitch in view of Carr	1, 2, 5, 6, 9-12 and 15-21

Ground	35 USC	Index of References	Claims
3	§ 103	Bouevitch in view of Sparks	1-4, 17 and 22
4	§ 103	Smith in view of Tew	1-6, 9-12 and 15-22
5	§ 103	Bouevitch in view of Carr and Tew	1, 2, 5, 6, 9-12 and 15-21
6	§ 103	Bouevitch in view of Sparks and Tew	1-4, 17 and 22

Claims 1-6, 9-12, and 15-22 of the '368 patent would have been obvious to a PHOSITA by the art cited in the grounds of unpatentability described above. In the attached declaration, Dr. Drabik provides a thorough discussion of the state of the art at the time of this alleged "invention." Ex. 1016 at ¶¶ 24-59, Drabik Decl. His declaration makes clear that all the elements of all the Petitioned Claims lack invention. Ex. 1016 at ¶¶ 96-175, Drabik Decl.

B. Motivation to Combine References

Petitioner submits that no showing of specific motivations to combine the respective references in Grounds 2-6 (set forth below) is required, as the respective combinations would have no unexpected results, and at most would simply represent known alternatives to one of skill in the art. *See KSR Int'l Co. v. Teleflex, Inc.*, 127 S.Ct. 1727, 1739-40 (2007). Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 1742.

Nevertheless, specific motivations and reasons to combine the references are identified below.

C. Ground 1: Claims 1-6, 9-12 and 15-22 Are Anticipated by Smith

Claims 1-6, 9-12 and 15-22 are anticipated by Smith. *See* Ex. 1016 at ¶¶ 98-107, Drabik Decl.

Smith is a prior art reference to the '368 patent under § 102(e). Smith is entitled to a prior art date of September 22, 2000, the filing date of its earliest provisional application ("Smith Provisional"), because the portions of Smith relied upon are fully supported by the Smith Provisional. *See, e.g.*, *In re Giacomini*, 612 F.3d 1380 (Fed. Cir. 2010). The analysis below includes citations to both Smith and the Smith Provisional.

(i) Claim 1 preamble

The preamble of claim 1 recites an "optical add-drop apparatus comprising." Smith discloses an optical add-drop multiplexer. Ex. 1009 at 8:53-59, 12:4-12, Figs. 8-13; Ex. 1010 at 2:9-13, 4:9-17, 7:6-18, Figs. 1-6; Ex. 1016 at ¶ 108.

(ii) Claim 1 – input port

The first limitation of claim requires "an input port for an input multi-wavelength optical signal having first spectral channels." Smith discloses an input port for a multi-wavelength WDM optical signal. Ex. 1009 at 8:40-59, Figs. 8-13; Ex. 1010 at 4:9-17, 7:6-18, Figs. 1-6; Ex. 1016 at ¶ 109.

(iii) Claim 1 – output and other ports

The second limitation of claim 1 requires "one or more other ports for second spectral channels; an output port for an output multi-wavelength optical signal." Smith discloses other ports, such as an add port and a drop port, and an output port. Ex. 1009 at 8:40-59, Figs. 8-13; Ex. 1010 at 4:9-17, 7:6-18, Figs. 1-6; Ex. 1016 at ¶ 110.

(iv) Claim 1 – wavelength selective device

The third element of claim 1 requires "a wavelength-selective device for spatially separating said spectral channels." Smith discloses a diffraction grating for spatially separating wavelength channels. Ex. 1009 at 4:16-29, 5:38-43, 12:29-42, Figs. 5, 6, 9, 11, 13; Ex. 1010 at 3:18-22, 4:18-21, 7:25-8:1, Figs. 1, 6, 8-10; Ex. 1016 at ¶ 111.

(v) Claim 1 – beam-deflecting elements

The final element of claim 1 requires "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port." Smith discloses a MEMS mirror array where each mirror receives a wavelength channel. Ex. 1009 at 3:66-4:12, 4:40-42, 4:56-60, 5:27-32, 12:39-50; 16:9-13, Figs. 5, 6, 16; Ex. 1010 at 3:16-24, 7:29-8:2, 8:5-11, 9:14-16,

Figs. 1-3, 6. Smith also discloses that each MEMS mirror is individually and continuously controllable in two dimensions to reflect a channel to a port. Ex. 1009 at Abstract, 7:1-3, 7:32-44, 8:19-20, 14:49-65, 15:35-54, 19:51-55, Figs. 14 and 16; Ex. 1010 at 6:3-7, 9:4-23, Fig. 7. Smith further discloses controlling the MEMS mirrors to control the power of the channel reflected to the port. Ex. 1009 at 7:32-45, 16:9-11, 16:34-51; Ex. 1010 at 6:3-7, 9:4-13, 10:1-20, Fig. 7. Thus, Smith discloses all of the requirements of this beam-deflecting elements limitation. *See* Ex. 1016 at ¶ 112.

(vi) Claim 2

Claim 2 recites "the optical add-drop apparatus of claim 1 further comprising a control unit for controlling each of said beam-deflecting elements." Smith discloses a controller for adjusting the positions of the micromirrors. Ex. 1009 at 9:20-33, 11:13-35, 13:21-24, 18:42-53, Figs. 11-13; Ex. 1010 at 7:3-4, 11:2-11, Figs. 4 and 11; *see* Ex. 1016 at ¶ 113.

(vii) Claim 3

Claim 3 recites the "optical add-drop apparatus of claim 2, wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements." Smith discloses a servo-control assembly comprising a

controller that receives feedback for controlling the micromirrors from an optical power monitor that measures the power of optical signals. Ex. 1009 at 7:24-31, 8:2-4, 9:29-33, 13:20-14:15, 18:42-53, Figs. 8 and 12; Ex. 1010 at 6:10-14, 11:4-23, Fig. 4; *see* Ex. 1016 at ¶ 114.

(viii) Claim 4

Claim 4 recites "wherein said servo-control assembly maintains said power levels at predetermined values." Smith discloses adjusting mirrors to predetermined criteria, which includes power levels. Ex. 1009 at 9:59-10:13, 11:48-51; Ex. 1010 at 6:10-14, 11:4-23, Fig. 4; *see* Ex. 1016 at ¶ 115.

(ix) Claim 5

Claim 5 requires the "optical add-drop apparatus of claim 2, wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said second ports to be dropped as second spectral channels from said output multi-wavelength optical signal." Smith discloses an add-drop apparatus that includes a control unit for directing channels to a drop port. *See supra* Sections VII.C.(i), (iii) & (vi); Ex. 1016 at ¶ 116.

(x) Claim 6

Claim 6 requires the "optical add-drop apparatus of claim 2, wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal." Smith discloses an add-drop apparatus that includes a

control unit for directing channels to an output port to be added. *See supra* Sections VII.C.(i), (iii) & (vi); Ex. 1016 at ¶ 117.

(xi) Claim 9

Claim 9 recites the "optical add-drop apparatus of claim 1, wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal." Smith discloses a wavelength selective device that combines spectral channels reflected from the MEMS mirrors to form a multiplexed output optical signal. Ex. 1009 at 5:8-15, 5:22-43, 8:53-59, 12:29-42; Figs. 5, 6, 8 and 9; Ex. 1010 at 8:5-13, Figs. 1 and 2; *see* Ex. 1016 at ¶ 118.

(xii) Claim 10

Claim 10 recites the "optical add-drop apparatus of claim 1, wherein said one or more other ports comprise an add port and a drop port for respectively adding second and dropping first spectral channels." Smith discloses an add port and a drop port for adding and dropping channels. *See supra* Section VII.C.(iii); Ex. 1016 at ¶ 119.

(xiii) Claim 11

Claim 11 requires the "optical add-drop apparatus of claim 1 further comprising a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements." Smith discloses a lens system for focusing the channels onto the MEMS mirrors. Ex. 1009 at 12:43-50, Figs. 9, 11, 13; Ex. 1010

at 7:29-8:3, Figs. 1, 8 and 9; *see* Ex. 1016 at ¶ 120.

(xiv) Claim 12

Claim 12 requires the "optical add-drop apparatus of claim 1, wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms." Smith discloses a parallel lined (*i.e.*, ruled) diffraction grating as a wavelength-selective device. Ex. 1009 at 12:29-39, Figs. 5, 6; Ex. 1010 at 7:25-29, Fig. 6; *see* Ex. 1016 at ¶ 121.

(xv) Claim 15

Claim 15 closely resembles claim 1 and includes elements similar to some of the requirements of claim 5. Smith discloses the elements of claim 15 for the same reasons stated with regard to claims 1 and 5, which are incorporated by reference. *See supra* Sections VII.C.(i)-(v) & (ix); Ex. 1016 at ¶ 122.

(xvi) Claim 16

Claim 16 closely resembles claim 1 and includes elements similar to some of the requirements of claim 6. Smith discloses the elements of claim 15 for the same reasons stated with regard to claims 1 and 6, which are incorporated by reference. *See supra* Sections VII.C.(i)-(v) & (x); Ex. 1016 at ¶ 123.

(xvii) Claim 17

Claim 17 is an independent method claim that has similarities with claim 1. The preamble requires "performing dynamic add and drop in a WDM optical

network." Smith discloses such a method using an optical add-drop multiplexer. *See supra* Section VII.C.(i). Smith discloses the claim 17 requirement of "separating an input multi-wavelength optical signal into spectral channels." *See supra* Section VII.C.(iv). Smith discloses the claim 17 requirement of "imaging each of said spectral channels onto a corresponding beam-deflecting element" for the same reasons stated with regard to claim 11. *See supra* Section VII.C.(xiii). Claim 17 also requires "controlling dynamically and continuously said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical signal." Apart from "controlling dynamically," Smith discloses the requirements of this limitation for the same reasons stated with regard to claims 1 and 9. *See supra* Sections VII.C.(v) & (xi). As to "controlling dynamically," Smith discloses dynamic feedback control. Ex. 1009 at 6:37-50; 2:23-31, 7:24-31; Ex. 1010 at 11:4-20; *see* Ex. 1016 at ¶ 124.

(xviii)Claim 18

Claim 18 requires the "method of claim 17, wherein said selected ones of said spectral channels comprises a subset of said spectral channels, such that other non-selected ones of said spectral channels are dropped from said output multi-wavelength optical signal." Claim 18 is substantively identical to portions of

claims 5 and 15 and is disclosed by Smith for the same reasons as discussed for those claims. *See supra* Sections VII.C.(ix) & (xv); Ex. 1016 at ¶ 125.

(xix) Claim 19

Claim 19 recites the "method of claim 18, wherein said controlling comprises reflecting said non-selected ones of said spectral channels to one or more drop ports." Claim 19 is also substantively identical to portions of claims 5 and 15 and is disclosed by Smith for the same reasons as discussed for those claims. *See supra* Sections VII.C.(ix) & (xv); Ex. 1016 at ¶ 126.

(xx) Claim 20

Claim 20 recites the "method of claim 17 further comprising imaging other spectral channels onto other corresponding beam-deflecting elements, and controlling dynamically and continuously said other beam-deflecting elements so as to combine said other spectral channels with said selected ones of said spectral channels into said output multi-wavelength optical signal." Smith discloses imaging multiple channels on multiple MEMS mirrors. Ex. 1009 at 8:40-61, 11:52-57, 12:4-11, 12:43-50, 16:9-13; Ex. 1010 at 2:3-5, 7:29-8:2, 9:14-16, 10:14-20. Smith discloses the other limitations of this claim for the same reasons as discussed with regard to claim 17. *See supra* Section VII.C.(xvii); Ex. 1016 at ¶ 127.

(xxi) Claim 21

Claim 21 recites the "method of claim 17, wherein said imaging comprises

focusing said spectral channels onto said beam-deflecting elements." Smith discloses this limitation for the same reasons stated with regard to claim 11. *See supra* Section VII.C.(xiii); Ex. 1016 at ¶ 128.

(xxii) Claim 22

Claim 22 recites the "method of claim 17 further comprising monitoring a power level in one or more of said selected ones of said spectral channels, and controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring." Smith discloses this limitation for the same reasons stated with regard to claim 3. *See supra* Section VII.C.(vii); *see also* Ex. 1009 at 18:11-21; Ex. 1016 at ¶ 129.

D. Ground 2: Claims 1, 2, 5, 6, 9-12 and 15-21 would have been obvious by the combination of Bouevitch and Carr

Claims 1, 2, 5, 6, 9-12 and 15-21 of the '368 patent would have been obvious over Bouevitch in view of Carr. Each element of these claims is either disclosed or would be an obvious variant on the teachings of Bouevitch and Carr.

Bouevitch is a prior art reference to the '368 patent under § 102(e). Bouevitch is entitled to a prior art date of at least its filing date of December 5, 2000, which is before the earliest effective filing date of March 19, 2001 for the '368 patent. After disclosing Bouevitch and stating that "***Claim 1 is deemed to be too broad and invalid in view of U.S. Patent No. 6,498,872 to Bouevitch***" and other references, Capella has never claimed that Bouevitch is not prior art.

Bouevitch discloses a configurable optical add/drop multiplexer ("COADM") that uses MEMS mirrors for routing signals. Ex. 1002 at Abstract; *see* Ex. 1016 at ¶¶ 132-138, Drabik Decl. By tilting its MEMS mirrors, the Bouevitch COADM switches an input spectral channel to either an output port or a drop port. *Id.* at 14:14-15:18, Fig. 11. The Bouevitch COADM can also add a new channel in place of a dropped channel. *Id.* Bouevitch's COADM uses MEMS mirrors with one axis of rotation. *E.g.*, *id.* at 7:23-37 (describing tilting mirrors along one axis).

Carr is a prior art reference to the '368 patent under § 102(e). Carr is entitled to a prior art date of at least its filing date of November 3, 2000, which is before the earliest effective filing date of March 19, 2001 for the '368 patent. Carr discloses a MEMS mirror device for optical signal processing in power equalizers, variable attenuators and optical add/drop multiplexing. Ex. 1005 at 1:6-10, 11:11-13; *see* Ex. 1016 at ¶¶ 139-140, Drabik Decl. Carr discloses a two-dimensional array of double-gimbaled mirrors that can be tilted about two perpendicular torsion bars to any desired orientation. *Id.* at 3:44-47; 3:66-4:2. Carr discloses power control or attenuation by tilting the MEMS mirrors to orientations such that only a portion of input signals that are reflected off the MEMS mirrors enters the output fibers. *Id.* at 11:13-20. Carr also states that the MEMS mirrors may be oriented in a manner to drop a signal by reflecting the input signal to no output fiber or add a channel to an output fiber by orienting a mirror to reflect a new input to the output.

Id. at 11:26-33.

A PHOSITA would have been motivated to combine Bouevitch with Carr for a number of independent reasons. *See* Ex. 1016 ¶ 141. Fundamentally, the two references cover highly related subject matter. Each reference discusses devices in the same field of fiber optic communications. Ex. 1005 at 1:6–15; Ex. 1002 at 1:10–19. Each reference is directed at the same application in that field—optical switching for wavelength-division-multiplexed (WDM) communications. Each reference discloses an optical add/drop switch using a MEMS-based WSS for switching. As a result, using the known 2-axis mirrors from Carr in the Bouevitch COADM would have been nothing more than using known techniques to improve similar devices. Because of the similarity between the devices disclosed in each reference, a PHOSITA would expect that each of these well-known techniques could be applied to the devices of the other patent.

A PHOSITA would find it natural and obvious to combine teachings of Carr with the disclosure of Bouevitch. Ex. 1016 ¶ 142, Drabik Decl. Namely, providing the MEMS mirrors of Bouevitch with two-axis tilt capability enables the spatial positioning of returning beams in both transverse directions at the face of microlens array 12. Thus, errors in system alignment arising, e.g., from imperfect assembly or temperature changes—well known problems in free space optical systems—could be better compensated. Likewise, a PHOSITA would seize upon

Carr's teachings of feedback control for improved stabilization of mirror position and out-coupled optical power.

For example, a PHOSITA would have been motivated to combine the two-axis movable MEMS mirrors of Carr in the COADM of Bouevitch based on the teachings of the references, common sense and knowledge generally available to a PHOSITA, as the proposed combination would merely be substituting known elements to yield predictable results. Bouevitch discloses a COADM where multi-wavelength light is spatially dispersed into channels by a diffraction grating and each channel is reflected by a different mirror in an array of MEMS mirrors along a different path for adding and dropping optical signals. Ex. 1002 at 14:14–15:18, Fig. 11. Carr discloses a two-dimensional array of double-gimbaled (i.e., two axes) movable MEMS mirrors that can be tilted to "any desired orientation." Ex. 1005 at 3:44–48. As a result, using the known two-axis mirrors of Carr in the Bouevitch COADM is nothing more than substituting known elements to yield predictable results. Ex. 1016 ¶ 143, Drabik Decl.

Also, it would have been obvious to try Carr's two-axis mirrors in Bouevitch because two-axis mirrors were among a small number of identified, predictable solutions, and a PHOSITA had a high expectation of success with two-axis mirrors. Ex. 1016 ¶ 144. There are only two options for tilting MEMS mirrors: one-axis and two-axis mirrors. Because Carr already disclosed the use of

two-axis mirrors (which were available by the '368 Patent's priority date), a PHOSITA would have a high expectation of success upon trying two-axis mirror control in Bouevitch. *Id.* The impact of tilting in one or two axes for the steering of a light beam was entirely predictable to a PHOSITA. *See* Exs. 1018, 1025.

Additionally, a PHOSITA would have been motivated to combine the continuously controllable mirrors of Carr with the COADM of Bouevitch. A PHOSITA would have been motivated to combine the teachings of these references at least for the following reasons: (1) continuously controlled mirrors were known to be an alternative to digital (discretely positioned) mirrors; (2) continuously controlled mirrors allow arbitrary positioning of mirrors and provide more precise control of reflected signals; and (3) Carr specifically teaches that its analog, continuous micromirrors would be useful for power control applications in WDM systems. Ex. 1005 at 11:20–23.

The prior art teaches that continuously controllable mirrors were an interchangeable alternative to digital (discrete-step) mirrors. See, e.g., Ex. 1007 at [0030]; Ex. 1008 at 9:9–15; Ex. 1033 at 2:7–9, 3:41–57. A PHOSITA would have known that MEMS mirrors based on analog voltage control can be tilted to any desired angle in their operation range. Ex. 1016 ¶¶ 145-147, Drabik Decl.

A PHOSITA would have known to use continuously controllable mirrors to equalize or otherwise attenuate an optical signal. Carr teaches that the mirrors

"can be tilted to any desired orientation" and that "[f]ine control over the mirror orientation" provides "fine control of the degree of attenuation." Ex. 1005 at 1:49–50, 3:47–48, 11:20–23. In addition, other prior art references recognize that having individual control over each channel of an optical signal by continuously altering the position of each mirror provides control on a channel basis and allows for power balancing. *See, e.g.*, Ex. 1007 at [0017], [0038]. Thus, a PHOSITA would have been motivated to use continuously controllable micromirrors of Carr in the device of Bouevitch to equalize or otherwise attenuate an optical signal.

As another example, a PHOSITA would have been motivated to combine the power control method and input/output ports of Carr in the COADM of Bouevitch. Ex. 1016 ¶ 148, Drabik Decl. Bouevitch discloses a COADM where multi-wavelength light is spatially dispersed into channels by a diffraction grating and each channel is reflected by a different mirror in a MEMS array along a different path for adding and dropping optical signals. Ex. 1002 at 14:14–15:18, FIG. 11. Carr discloses a power control method of orienting each of the double-gimbaled, two axis movable MEMS mirrors so that only a portion of a signal reflected off each MEMS mirror enters an optical fiber. Ex. 1005 at 11:11–20. A PHOSITA would have known that power control of each channel may be achieved by intentional misalignment of the reflected beam so that only a portion of the signal enters the output port. *Id.*; *see also* Ex. 1006 at 4:48–58; Ex. 1007 at

[0030], [0038]; Ex. 1008 at 9:9–15.

Bouevitch recognizes that the degree of attenuation may be based on the angle of deflection off each MEMS mirror. Ex. 1002 at 7:31–37. Although Bouevitch does not expressly disclose intentional misalignment into an output port as a method to achieve attenuation, Bouevitch recognizes the principle that angular displacement may be used as the root mechanism to attenuate to signal. *See id.* Bouevitch does not teach away from angular displacement as an attenuation mechanism, rather it only recognizes that there is no need to intentionally misalign a signal into an output port for purposes of attenuation where the signal has already been attenuated elsewhere in the optical system. *See id.* at 7:41–43 ("As a result the attenuated sub-beam is refracted in the birefringent element 156 and is directed out of the device to port 102 b."). Carr teaches that MEMS mirrors may be oriented to intentionally misalign signals into output ports for purposes of power control of each channel. Ex. 1005 at 11:13–25. Additionally, Carr discloses an array of input/output ports through which only a portion of the optical signals may enter for power control. *Id.* at 11:13–33, FIG. 1b. A PHOSITA would have recognized that Carr provides an alternative attenuation technique that does not require the use of birefringent elements as disclosed in Bouevitch. Ex. 1016 ¶ 149, Drabik Decl. Other references expressly state that attenuation by intentional misalignment obviates the need for separate attenuation devices. Ex.

1006 at 4:48–58 (stating that by deliberately misaligning the optical beam path "attenuation is achieved without incorporating separate attenuator(s) within the system"). Thus, a PHOSITA would have been motivated to use the power control method and input/output ports of Carr in the COADM disclosed in Bouevitch, in order to attenuate optical signals. Ex. 1016 ¶ 149, Drabik Decl.

Additionally, the references are in a common field of endeavor (routing optical signals using MEMS-based WSSs), with a finite number of conventional and predictable solutions to the routing issues addressed by the references, such that it would have been obvious to try one of the solutions described in Carr (e.g., two-axis mirrors and misalignment for power control) with the COADM device disclosed in Bouevitch, with a reasonable expectation of success.

The following chart and discussion herein show, as supported by Dr. Drabik, that the claimed subject matter would have been obvious over Bouevitch in view of Carr. Ex. 1016 at ¶¶ 130-151, Drabik Decl.

Claims of the '368 Patent	
[1pre] An optical add-drop apparatus comprising	Bouevitch discloses an optical add-drop apparatus. Bouevitch discloses "optical device for rerouting and modifying an optical signal that is capable of operating as a dynamic gain equalizer (DGE) and/or a configurable optical add/drop multiplexer (COADM)." Ex. 1002 at Abstract. Bouevitch discloses a "preferred embodiment is illustrated in FIG. 11, wherein an arrangement similar to that shown in FIG. 9 designed to operate as a COADM, is shown. Optical

Claims of the '368 Patent	
	circulators 80 a and 80 b are coupled to each of the optical waveguides 99 a and 99 b, respectively, for separating in/out and add/drop optical signals. Optical waveguides 99 a and 99 b are optically coupled to microlenses 12 a and 12 b disposed on one side of the lens 90." *Id*. at 14:14-21; *see also id*. at 5:15-20; 14:22-38; Figs. 1, 11; Ex. 1016 at ¶ 151[1pre].
[1a] an input port for an input multi-wavelength optical signal having first spectral channels;	Bouevitch discloses an input port for an input multi-wavelength optical signal having first spectral channels. Bouevitch discloses "For exemplary purposes, ***the beam of light is assumed to include wavelengths λ_1 and λ_2, however, in practice more wavelengths are typically used. In operation, the beam of light carrying wavelengths λ_1 and λ_2, is launched into port 1 of the first optical circulator 80 a and is circulated to optical waveguide 99 a supported by sleeve 96***. The beam of light is transmitted through the microlens 12 *a* to the lens 90, in a direction substantially parallel to the optical axis (OA_2) of the lens 90." *Id*. at 14:36-44 (emphasis added). *See* Ex. 1016 at ¶ 151[1a]. Capella has admitted that Bouevitch discloses this limitation: "waveguide 99a comprises *a port* for in/out signals." IPR2014-01166, Paper No. 7 at 41. Carr discloses an input port for an input multi-wavelength optical signal having first spectral channels. Carr discloses that "FIG. 1(b) schematically illustrates an important application of optical MEMs mirrors as controllable mirror arrays for optical signal routing. The cross connect system shown here comprises optical input fibers 120, optical output fibers 121 and an array of MEMs mirrors 122 on a substrate 123. The optical signals from the input fibers 120 are incident on aligned mirrors 122. The mirrors 122, with the aid of a fixed auxilliary mirror 124 and appropriate imaging lenses 125, are electrically controlled to reflect the incident optical signals to respective output fibers 121. In

Claims of the '368 Patent	
	alternative schemes, the input fibers and the output fibers are in separate arrays, and a pair of MEMs mirror arrays are used to perform the cross connect function." Ex. 1005 at 1:58-2:3; Fig. 1B (showing five input/output fibers).
[1b] one or more other ports for second spectral channels; an output port for an output multi-wavelength optical signal;	Bouevitch discloses one or more other ports for second spectral channels and an output port for an output multi-wavelength optical signal. *See* Ex. 1016 at ¶ 151[1b]. Bouevitch discloses one or more other ports for second spectral channels identified as 80b, port 1, "IN ADD" and 80b, port 3, "OUT DROP." Ex. 1002 at Fig. 11. Bouevitch discloses "Referring to FIG. 11, reflector 51 is orientated such that the sub-beam of light corresponding to λ_1 incident thereon, is reflected back along the same optical path to the lens 90, passes through port 85 again, and propagates to port 2 of circulator 80 a where it is circulated to port 3. Reflector 52, however, is orientated such that the sub-beam of light corresponding to λ_2 is reflected back along a different optical path. Accordingly, ***the dropped signal corresponding to wavelength λ_2 is returned to the lens 90, passes through port 87, propagates to port 2 of the second circulator 80 b, and is circulated to port 3. Simultaneously, a second beam of light having central wavelength λ_2 is added into port 1 of the second optical circulator 80 b and is circulated to optical waveguide 99 b***." *Id.* at 14:55-15:1 (emphasis added); Fig. 11. Bouevitch discloses an output port for an output multi-wavelength optical signal identified as "OUT EXPRESS." *Id.* at Fig. 11. Bouevitch discloses "Reflector 52 is orientated such that the second beam of light corresponding to λ_2 is reflected back along a different optical path to the spherical reflector 10, where it is directed to the diffraction grating. ***At the diffraction grating, the added optical signal***

Claims of the '368 Patent	
	corresponding to λ_2 is combined with the express signal corresponding to λ_1. The multiplexed signal is returned to the lens 90, passes through port 85, and returns to port 2 of the first circulator 80 a where it is circulated out of the device from port 3." *Id.* at 15:10-18 (emphasis added); Fig. 11. Carr also discloses one or more other ports for second spectral channels and an output port for an output multi-wavelength optical signal. Ex. 1005 at 1:58-2:3; Fig. 1B (showing five input/output fibers).
[1c] a wavelength-selective device for spatially separating said spectral channels;	Bouevitch discloses a wavelength-selective device for spatially separating said spectral channels. Bouevitch discloses that the "***emerging beam of light $\lambda_1\lambda_2$***, is transmitted to an upper portion of the spherical reflector 10, is reflected, and ***is incident on the diffraction grating 20, where it is spatially dispersed into two sub-beams of light carrying wavelengths λ_1 and λ_2, respectively***. Each sub-beam of light is transmitted to a lower portion of the spherical reflector 10, is reflected, and is transmitted to separate reflectors 51 and 52 of the MEMS array 50." Ex. 1002 at 14:48-55 (emphases added); Fig. 11; *see* Ex. 1016 at ¶ 151[1c].
[1d] a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding	Bouevitch discloses a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels and is individually controllable. *Id.* at 14:48-55 (emphasis added). Carr discloses a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port. Carr discloses a spatial array of beam-deflecting elements

Claims of the '368 Patent	
spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port.	being individually and continuously controllable in two dimensions: Carr discloses the "***gimballed mirror 21 can be a double-gimballed, cantilevered mirror*** and is coupled to the frame structure 22 of layer 20 by torsion bars or springs (not shown). ***Hence the mirror 21 can be tilted to any desired orientation***. Each mirror 21 can be electrically grounded and tilted for optical signal routing via electrostatic actuation by one or more electrodes 24 placed underneath the mirror." *Id.* at 3:45-51; *see also id.* at 1:40-52, 3:66-4:2; *see* Figs 1a and 2b. Carr discloses that each mirror reflects a corresponding spectral channel to a selected port: "For a switch or an add/drop switch, in an arrangement similar to FIG. 1(b), ***the mirror for a channel to be switched off, dropped or rerouted is oriented to reflect the input signal to a different output fiber or to no output fiber, as desired. Hence the signal is rerouted, dropped or switched off. A channel is readily added to an output fiber by a mirror reoriented to reflect a new input to the output***." *Id.* at 11:26-33. Carr discloses controlling the power of the spectral channel reflected by intentional misalignment: "The inventive device is also useful for various other light-reflecting mirror systems such as power equalizers, variable attenuators, optical add/drop and switches. FIG. 9 illustrates a variable attenuator using the common principle upon which such systems are based. ***Assume that an input fiber 90 transmits an input signal 91 to be attenuated and sent to output fiber 92. Then controllable mirror 21 is positioned for receiving signal 91 and is oriented for reflecting the signal so that only a portion of the reflected***

Claims of the '368 Patent	
	signal 93 enters the output fiber 92. Fine control of the mirror orientation permitted by the accurate spacing and alignment of solder bonding assembly permits fine control of the degree of attenuation. *Id.* at 11:11-23 (emphasis added); *see* Fig. 9; Ex. 1016 at ¶ 151[1d].
[2] The optical add-drop apparatus of claim 1 further comprising a control unit for controlling each of said beam-deflecting elements.	Claim 2 depends from claim 1, which would have been obvious for the reasons discussed above in [1pre] through [1d]. Carr discloses a control unit for controlling each of said beam-deflecting elements. Carr discloses that "Electrodes are disposed in a cavity underlying the mirror and the gimbal. Voltages applied between the mirror and an underlying electrode and between the gimbal and an electrode control the orientation of the mirror. Alternatively, in slightly modified arrangements, an electrical signal can control the position of the mirror magnetically or piezoelectrically." Ex. 1005 at 1:32-38. Carr discloses that "***mirrors 122***, with the aid of a fixed auxilliary mirror 124 and appropriate imaging lenses 125, ***are electrically controlled to reflect the incident optical signals to respective output fibers 121***. In alternative schemes, the input fibers and the output fibers are in separate arrays, and a pair of MEMs mirror arrays are used to perform the cross connect function. ***The tilting of each mirror is controlled by applying specific electric fields to one or more of the electrodes (not shown) beneath the mirror***." *Id.* at 1:64-2:6; *see also id.* at 12:43-51; Ex. 1016 at ¶ 151[2].
[5] The optical add-drop apparatus of claim 2, wherein the control unit controls said beam-deflecting	Claim 5 depends from claim 2, which would have been obvious for the reasons discussed above in [2]. Bouevitch discloses that the control unit controls the beam-deflecting elements to direct selected ones of the first

Claims of the '368 Patent	
elements to direct selected ones of said first spectral channels to one or more of said second ports to be dropped as second spectral channels from said output multi-wavelength optical signal.	spectral channels to one or more of the second ports to be dropped as second spectral channels from the output multi-wavelength optical signal. Ex. 1002 at 14:52-65; *see* Ex. 1016 at ¶ 151[5].
[6] The optical add-drop apparatus of claim 2, wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal.	Claim 6 depends from claim 2, which would have been obvious for the reasons discussed above in [2]. Bouevitch discloses that the control unit controls the beam-deflecting elements to direct selected ones of the second spectral channels to the output port to be added to the output multi-wavelength optical signal. *Id.* at 14:66-15:18; *see* Ex. 1016 at ¶ 151[6].
[9] The optical add-drop apparatus of claim 1, wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal.	Claim 9 depends from claim 1, which would have been obvious for the reasons discussed above in [1pre] through [1d]. Bouevitch discloses that the wavelength selective device combines selected spectral channels reflected from the beam-deflecting elements to form the output multi-wavelength optical signal. Bouevitch discloses as follows: "***At the diffraction grating, the added optical signal corresponding to λ_2 is combined with the express signal corresponding to λ_1. The multiplexed signal is returned to the lens 90, passes***

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	***through port 85, and returns to port 2 of the first circulator 80 a where it is circulated out of the device from port 3*.” *Id.* at 15:13-18 (emphasis added); Fig. 11; *see* Ex. 1016 at ¶ 151[9].
[10] The optical add-drop apparatus of claim 1, wherein said one or more other ports comprise an add port and a drop port for respectively adding second and dropping first spectral channels.	Claim 10 depends from claim 1, which would have been obvious for the reasons discussed above in [1pre] through [1d]. Bouevitch discloses wherein one or more other ports comprise an add port and a drop port for respectively adding second and dropping first spectral channels. Bouevitch discloses one or more other ports for second spectral channels identified as 80b, port 1, “IN ADD” and 80b, port 3, “OUT DROP.” Ex. 1002 at Fig. 11; *see also id.* at 14:55-15:1; Fig. 11; Ex. 1016 at ¶ 151[10].
[11] The optical add-drop apparatus of claim 1 further comprising a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements.	Claim 11 depends from claim 1, which would have been obvious for the reasons discussed above in [1pre] through [1d]. Bouevitch discloses a beam-focuser for focusing the separated spectral channels onto the beam deflecting elements. Bouevitch discloses that the “diffraction grating 620 separates each of the two sub-beams into a plurality of sub-beams of light having different central wavelengths. ***The plurality of sub-beams of light are transmitted to the spherical reflector 610 where they are collimated and transmitted to the modifying means 150 where they are incident thereon as spatially separated spots corresponding to individual spectral channels*.” *Id.* at 10:40-47 (emphasis added); *see also id.* at 14:48-55, 15:7-11, Figs. 6a, 11; Ex. 1016 at ¶ 151[11].
[12] The optical add-drop apparatus of claim 1, wherein	Claim 12 depends from claim 1, which would have been obvious for the reasons discussed above in [1pre] through [1d].

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said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms.	Bouevitch discloses a wavelength-selective device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms. Bouevitch discloses the use of prisms as wavelength selective devices through Bouevitch's incorporation by reference of U.S. Patent No. 5,414,540 ("Patel"). *Id.* at 1:34-39 ("In particular, it is common to provide a first diffraction grating for demultiplexing the optical signal and a second spatially separated diffraction grating for multiplexing the optical signal after it has been modified. An example of the latter is disclosed in US. Pat. No. 5,414,540, incorporated herein by reference."). Patel discloses that prisms along with diffraction gratings are examples of "frequency dispersive mediums." Ex. 1022 at 3:20-36; *see* Ex. 1016 at ¶ 151[12].
[15pre] An optical add-drop apparatus, comprising	Bouevitch discloses an optical add-drop apparatus, for the reasons described in [1pre]. *See* Ex. 1016 at ¶ 151[15pre].
[15a] an input port for an input multi-wavelength optical signal having multiple spectral channels;	Bouevitch discloses an input port for an input multi-wavelength optical signal having multiple spectral channels, for the reasons described in [1a]. *See* Ex. 1016 at ¶ 151[15a].
[15b] an output port for an output multi-wavelength optical signal;	Bouevitch discloses an output port for an output multi-wavelength optical signal, for the reasons described in [1b]. *See* Ex. 1016 at ¶ 151[15b]
[15c] one or more drop ports for selected spectral channels dropped from said multi-wavelength optical	Bouevitch discloses one or more drop ports for selected spectral channels dropped from the multi-wavelength optical signal. Bouevitch discloses one or more drop ports for selected spectral channels identified as 80b, port 3, "OUT DROP."

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signal;	Ex. 1002 at Fig. 11; *see also id*. at 14:55-65; *see* Ex. 1016 at ¶ 151[15c].
[15d] a wavelength-selective device for spatially separating said multiple spectral channels; and	Bouevitch discloses a wavelength-selective device for spatially separating the multiple spectral channels, for the reasons described in [1c]. *See* Ex. 1016 at ¶ 151[15d].
[15e] a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port,	Bouevitch and Carr disclose a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of the spectral channels, each of the elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of the ports and to control the power of the spectral channel reflected to the selected port, for the reasons stated in [1d]. *See* Ex. 1016 at ¶ 151[15e].
[15f] whereby a subset of said spectral channels is directed to said drop ports.	Bouevitch discloses that a subset of the spectral channels is directed to drop ports. Bouevitch discloses dropping channel λ_2 and directing it to OUT DROP port. Ex. 1002 at 14:60-65; Fig. 11. *See* Ex. 1016 at ¶ 151[15f].
[16pre] An optical add-drop apparatus,	Bouevitch discloses an optical add-drop apparatus, for the reasons described in [1pre]. *See* Ex. 1016 at ¶ 151[16pre].

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comprising	
[16a] an input port for an input multi-wavelength optical signal having multiple spectral channels;	Bouevitch discloses an input port for an input multi-wavelength optical signal having multiple spectral channels, for the reasons described in [1a]. *See* Ex. 1016 at ¶ 151[16a].
[16b] an output port for an output multi-wavelength optical signal;	Bouevitch discloses an output port for an output multi-wavelength optical signal, for the reasons described in [1b]. *See* Ex. 1016 at ¶ 151[16b].
[16c] one or more add ports for selected spectral channels to be added to said output multi-wavelength optical signal;	Bouevitch discloses one or more add ports for selected spectral channels to be added to the output multi-wavelength optical signal. Bouevitch discloses one or more add ports for selected spectral channels identified as 80b, port 1, "IN ADD." Ex. 1002 at Fig. 11; *see also id.* at 14:55-15:1; Ex. 1016 at ¶ 151[16c].
[16d] a wavelength-selective device for reflecting said multiple and said selected spectral channels; and	Bouevitch discloses a wavelength-selective device for reflecting said multiple and said selected spectral channels, for the reasons described in [1c]. *See* Ex. 1016 at ¶ 151[16d].
[16e] a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two	Bouevitch and Carr disclose a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of the spectral channels, each of the elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of the ports and to control the power of the spectral channel reflected to the selected port, for the reasons stated in [1d]. *See* Ex. 1016 at ¶ 151[16e].

Claims of the '368 Patent	
dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port,	
[16f] whereby said spectral channels from said add ports are selectively provided to said output port.	Bouevitch discloses that the spectral channels from the add ports are selectively provided to the output port. Bouevitch discloses that channel λ_2 added at IN ADD port is provided to OUT EXPRESS port. Bouevitch discloses that "***a second beam of light having central wavelength λ_2 is added into port 1 of the second optical circulator 80 b and is circulated to optical waveguide 99 b***. The second beam of light λ_2 is transmitted through the microlens 12 b to the lens 90, in a direction substantially parallel to the optical axis (OA_2) of the lens 90. It enters the lens 90 through port 87 disposed off the optical axis (OA_2) and emerges from port 92 coincident with the optical axis (OA_2) at an angle to the optical axis. The emerging beam of light is transmitted to an upper portion of the spherical reflector 10, is reflected, and is incident on the diffraction grating 20, where it is reflected to reflector 52 of the MEMS array 50. Reflector 52 is orientated such that the second beam of light corresponding to λ_2 is reflected back along a different optical path to the spherical reflector 10, where it is directed to the diffraction grating. ***At the diffraction grating, the added optical signal corresponding to λ_2 is combined with the express signal corresponding to λ_1. The multiplexed signal is returned to the lens 90, passes through port 85, and returns to port 2 of the first circulator 80 a where it is circulated out of the device from port 3***." Ex. 1002 at

Claims of the '368 Patent	
	14:66-15:18 (emphases added); Fig. 11; *see* Ex. 1016 at ¶ 151[16f].
[17pre] A method of performing dynamic add and drop in a WDM optical network, comprising	Bouevitch discloses a method of performing dynamic add and drop in a WDM optical network. Bouevitch discloses an "optical device for rerouting and modifying an optical signal that is capable of operating as a dynamic gain equalizer (DGE) and/or a configurable optical add/drop multiplexer (COADM)." *Id.* at Abstract; *see also* 1:18-30; 5:15-20; 14:14-38; Figs. 1 and 11; Ex. 1016 at ¶ 151[17pre].
[17a] separating an input multi-wavelength optical signal into spectral channels;	Bouevitch discloses separating an input multi-wavelength optical signal into spectral channels. Bouevitch discloses that the "***emerging beam of light*** $\boldsymbol{\lambda_1\lambda_2}$, is transmitted to an upper portion of the spherical reflector 10, is reflected, and ***is incident on the diffraction grating 20, where it is spatially dispersed into two sub-beams of light carrying wavelengths*** $\boldsymbol{\lambda_1}$ ***and*** $\boldsymbol{\lambda_2}$***, respectively***." *Id.* at 14:48-52 (emphases added); Fig. 11; *see* Ex. 1016 at ¶ 151[17a].
[17b] imaging each of said spectral channels onto a corresponding beam-deflecting element; and	Bouevitch imaging each of the spectral channels onto a corresponding beam-deflecting element. Bouevitch discloses "***Each sub-beam of light*** is transmitted to a lower portion of the spherical reflector 10, is reflected, and ***is transmitted to separate reflectors 51 and 52 of the MEMS array 50***." *Id.* at 14:52-55; *see also id.* at 15:7-11; Figs. 6a and 11; Ex. 1016 at ¶ 151[17b].
[17c] controlling dynamically and continuously said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral	Bouevitch and Carr disclose controlling dynamically and continuously the beam-deflecting elements in two dimensions so as to combine selected ones of the spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into the output multi-wavelength optical signal. Bouevitch discloses dynamically controlling beam-

Claims of the '368 Patent	
channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical signal.	deflecting elements to combine selected spectral channels into an output multi-wavelength optical signal. Bouevitch discloses that "Each sub-beam of light is transmitted to a lower portion of the spherical reflector 10, is reflected, and is transmitted to separate reflectors 51 and 52 of the MEMS array 50. Referring to FIG. 11, reflector 51 is orientated such that the sub-beam of light corresponding to λ_1 incident thereon, is reflected back along the same optical path to the lens 90, passes through port 85 again, and propagates to port 2 of circulator 80 a where it is circulated to port 3….Reflector 52 is orientated such that the second beam of light corresponding to λ_2 is reflected back along a different optical path to the spherical reflector 10, where it is directed to the diffraction grating. At the diffraction grating, the added optical signal corresponding to λ_2 is combined with the express signal corresponding to λ_1. The multiplexed signal is returned to the lens 90, passes through port 85, and returns to port 2 of the first circulator 80 a where it is circulated out of the device from port 3." *Id.* at 14:52-60; 14:66-15:18; Fig. 11. Carr discloses dynamically and continuously controlling the beam-deflecting elements in two dimensions so as to combine selected ones of the spectral channels into an output multi-wavelength optical signal. Carr discloses the "***gimballed mirror 21 can be a double-gimballed, cantilevered mirror*** and is coupled to the frame structure 22 of layer 20 by torsion bars or springs (not shown). ***Hence the mirror 21 can be tilted to any desired orientation***. Each mirror 21 can be electrically grounded and tilted for optical signal routing via electrostatic actuation by one or more electrodes 24 placed underneath the mirror." *Id.* at 3:45-51; *see also id.* at 1:40-52, 3:66-4:2, Figs. 1a, 2b.

Claims of the '368 Patent	
	Carr discloses that for "a switch or an add/drop switch, in an arrangement similar to FIG. 1(b), the mirror for a channel to be switched off, dropped or rerouted is oriented to reflect the input signal to a different output fiber or to no output fiber, as desired. Hence the signal is rerouted, dropped or switched off. ***A channel is readily added to an output fiber by a mirror reoriented to reflect a new input to the output***." *Id.* at 11:26-33. Carr discloses controlling the power of the spectral channels combined into the output multi-wavelength optical signal by intentional misalignment: "The inventive device is also useful for various other light-reflecting mirror systems such as power equalizers, variable attenuators, optical add/drop and switches. FIG. 9 illustrates a variable attenuator using the common principle upon which such systems are based. ***Assume that an input fiber 90 transmits an input signal 91 to be attenuated and sent to output fiber 92. Then controllable mirror 21 is positioned for receiving signal 91 and is oriented for reflecting the signal so that only a portion of the reflected signal 93 enters the output fiber 92***. Fine control of the mirror orientation permitted by the accurate spacing and alignment of solder bonding assembly permits fine control of the degree of attenuation. *Id.* at 11:11-23 (emphasis added); *see* Fig. 9; Ex. 1016 at ¶ 151[17c].
[18] The method of claim 17, wherein said selected ones of said spectral channels comprises a subset of said spectral channels, such that other non-selected ones of said spectral channels are	Claim 18 depends from claim 17, which would have been obvious for the reasons discussed above in [17pre] through [17c]. Bouevitch discloses that selected ones of spectral channels comprise a subset of the spectral channels and other non-selected ones of the spectral channels are dropped from the output multi-wavelength optical signal. Ex. 1002 at 14:48-65; Fig. 11; *see* Ex. 1016 at ¶ 151[18].

Claims of the '368 Patent	
dropped from said output multi-wavelength optical signal.	
[19] The method of claim 18, wherein said controlling comprises reflecting said non-selected ones of said spectral channels to one or more drop ports.	Claim 19 depends from claim 18, which would have been obvious for the reasons discussed above in [18]. Bouevitch discloses that controlling comprises reflecting said non-selected ones of said spectral channels to one or more drop ports. *Id*. at 14:48-65; Fig. 11; *see* Ex. 1016 at ¶ 151[19].
[20] The method of claim 17 further comprising imaging other spectral channels onto other corresponding beam-deflecting elements, and controlling dynamically and continuously said other beam-deflecting elements so as to combine said other spectral channels with said selected ones of said spectral channels into said output multi-wavelength optical signal.	Claim 20 depends from claim 17, which would have been obvious for the reasons discussed above in [17pre] through [17c]. Bouevitch and Carr disclose imaging other spectral channels onto other corresponding beam-deflecting elements, and controlling dynamically and continuously the other beam-deflecting elements so as to combine said other spectral channels with the selected ones of the spectral channels into the output multi-wavelength optical signal. Bouevitch discloses arbitrarily-sized ROADMs and explicitly discusses embodiments that process additional channels by selectively reflecting them to respective deflecting elements. Ex. 1002 at 8:8-43 (discussing dropping λ_3, while passing through "the other 7 channels having central wavelengths λ_1-λ_2 and λ_4-λ_8"). Carr discloses "For a switch or an add/drop switch, in an arrangement similar to FIG. 1(b), the mirror for a channel to be switched off, dropped or rerouted is oriented to reflect the input signal to a different output fiber or to no output fiber, as desired. Hence the signal is rerouted, dropped or switched off. A channel is readily added to an output fiber by a mirror reoriented to reflect a new input to the output." Ex. 1005 at 11:26-33; *see* Fig. 1b (showing five input/output fibers); *see*

Claims of the '368 Patent	
	Ex. 1016 at ¶ 151[20].
[21] The method of claim 17, wherein said imaging comprises focusing said spectral channels onto said beam-deflecting elements.	Claim 21 depends from claim 17, which would have been obvious for the reasons discussed above in [17pre] through [17c]. Bouevitch discloses that imaging comprises focusing the spectral channels onto the beam-deflecting elements. Bouevitch discloses that the "diffraction grating 620 separates each of the two sub-beams into a plurality of sub-beams of light having different central wavelengths. ***The plurality of sub-beams of light are transmitted to the spherical reflector 610 where they are collimated and transmitted to the modifying means 150 where they are incident thereon as spatially separated spots corresponding to individual spectral channels***." *Id.* at 10:40-47 (emphasis added); *see also id.* at 15:7-11, Figs. 6a and 11; Ex. 1016 at ¶ 151[21].

E. Ground 3: Claims 1-4, 17 and 22 would have been obvious by the combination of Bouevitch and Sparks

Claims 1-4, 17 and 22 of the '368 patent would have been obvious over Bouevitch in view of Sparks. Each element of these claims is either disclosed or would be an obvious variant on the teachings of Bouevitch and Sparks.

Sparks is a prior art reference to the '368 patent under § 102(e). Sparks is entitled to a prior art date of at least its filing date of December 29, 1999, which is before the earliest effective filing date of March 19, 2001 for the '368 patent. Sparks discloses an optical switch for attenuating optical signals in a wavelength division multiplexed (WDM) system. Ex. 1006 at 1:6-8, 4:3-14. Sparks describes

an optical switch comprising arrays of MEMS mirrors capable of two axis movement. *Id.* at 4:43-45. Sparks also explains that each of the channels "may be attenuated to whatever degree necessary to achieve the desired effect." *Id.* at 2:33-35. Sparks further discloses that the optical switch includes a closed-loop servo control system in which the input and/or output optical signals are measured and a control means receives a signal indicative of the power of the optical signal. *Id.* at 2:49-65; 4:39-42; 4:59-67. Sparks explains that the control means controls the operation of the MEMS mirrors to misalign the paths of the reflected beams to achieve a predetermined output power for each of the channels passing through the switch. *Id.* at 2:45-48; 6:2-10.

A PHOSITA would have been motivated to combine Bouevitch with Sparks for a number of independent reasons. A PHOSITA would have been motivated to combine Bouevitch with Sparks for many of the same reasons as discussed above with respect to the combination of Bouevitch and Carr. Thus, the motivations to combine of Ground 1 are incorporated herein by reference.

For example, a PHOSITA would have been motivated to combine the two-axis movable MEMS mirrors of Sparks in the COADM of Bouevitch based on the teachings of the references, common sense and knowledge generally available to a PHOSITA, as the proposed combination would merely be substituting known elements to yield predictable results. Bouevitch discloses a COADM where multi-

wavelength light is spatially dispersed into channels by a diffraction grating and each channel is reflected by a different mirror in an array of MEMS mirrors along a different path for adding and dropping optical signals. Ex. 1002 at 14:14-15:18, Fig. 11. Sparks discloses using movable micromirrors capable of two axes movement so that "each of the channels passing through the switch may be attenuated to whatever degree necessary to achieve the desired effect." Ex. 1006 at 2:30-35; 4:39-47. As a result, using the known two-axis mirrors of Sparks in the Bouevitch COADM entails nothing more than the use of known techniques to improve similar devices. Ex. 1016 ¶¶ 152-159, Drabik Decl.

A PHOSITA also would have been motivated to combine the power control method and input/output ports of Sparks within the COADM of Bouevitch. Ex. 1016 ¶ 160. Bouevitch discloses a COADM where multi-wavelength light is spatially dispersed into channels by a diffraction grating and each channel is reflected by a different mirror in a MEMS array along a different path for adding and dropping optical signals. Ex. 1002 at 14:14–15:18, FIG. 11. Sparks discloses deliberately misdirecting an optical beam path reflected from a moveable MEMS mirror so that only a portion of the beam power couples into an optical fiber, in order to achieve a desired output power. Ex. 1006 at 4:48–58; 5:1–11.

Bouevitch recognizes that the degree of attenuation may be based on the beam deflection angle imposed by each MEMS mirror. Ex. 1002 at 7:31–37.

Although Bouevitch does not expressly disclose intentional misalignment into an output port as a method to achieve attenuation, Bouevitch recognizes the principle that angular displacement may be used as the root mechanism to attenuate a signal. *See id.* Bouevitch does not teach away from angular displacement as an attenuation mechanism, rather it only recognizes that there is no need to deliberately misalign a signal into an output port for purposes of attenuation where the signal has already been attenuated elsewhere in the optical system. *See id.* at 7:41–43 ("As a result the attenuated sub-beam is refracted in the birefringent element 156 and is directed out of the device to port 102 b."). Sparks teaches that MEMS mirrors may be oriented intentionally to misalign signals into output ports for purposes of power control of each channel. Ex. 1006 at 2:26–39; 4:48–58. Additionally, Sparks discloses two input ports and two output ports through which only a portion of the optical signals may enter for power control. *Id.* at 2:66–3:9, FIG. 2b. A PHOSITA would have recognized that Sparks provides an alternative attenuation technique that does not require the use of the additional birefringent elements disclosed in Bouevitch. Ex. 1006 at 4:48–58. Thus, a PHOSITA would have been motivated to use the power control method and input/output ports of Sparks in the COADM disclosed in Bouevitch to attenuate optical signals. *Id.*; Ex. 1016 ¶ 161, Drabik Decl.

As a further example, a PHOSITA would have been motivated to combine

the servo control system of Sparks in the COADM of Bouevitch. Ex. 1016 ¶¶ 162-163, Drabik Decl. It would be obvious to a PHOSITA to combine the internal closed-loop servo control system of Sparks in Bouevitch as an alternative to the detector array used for purposes of gain equalization. Capella admitted that Figure 6b of Bouevitch illustrates a dynamic gain equalizer where detector array 657 is located inside the ROADM next to reflecting mirrors and that Bouevitch uses this approach to "'eliminat[e] the need for external feedback.'" IPR2014-01276, Paper No. 7 at 38–39 (quoting Ex. 1003 at 10:20–22). Sparks discloses a servo-control system within an optical switch that similarly eliminates the need for external feedback. Ex. 1006 at 4:39–67, Fig. 4; A PHOSITA would have been motivated to use the internal feedback system of Sparks in the COADM of Bouevitch "to ensure that the desired degree of attenuation of achieved for each optical signal (or channel)." Ex. 1006 at 2:62–65; *see also* Ex. 1001 at 12:9–15.

The following chart and discussion herein show, as supported by Dr. Drabik, that the claimed subject matter would have been obvious over Bouevitch in view of Sparks. Ex. 1016 at ¶¶ 152-164, Drabik Decl.

Claims of the '368 Patent	
[1pre] An optical add-drop apparatus comprising	Bouevitch discloses an optical add-drop apparatus for the reasons stated in Ground 2, [1pre]. *See* Ex. 1016 ¶ 164[1pre].
[1a] an input port for an input multi-wavelength optical	Bouevitch discloses an input port for an input multi-wavelength optical signal having first spectral channels for

Claims of the '368 Patent	
signal having first spectral channels;	the reasons stated in Ground 2, [1a]. *See* Ex. 1016 ¶ 164[1a]. Sparks discloses an input port for an input multi-wavelength optical signal having first spectral channels. Sparks discloses that "[p]referably, ***the optical switch comprises at least two inputs and two outputs***, and said measurement step comprises determining the relative ratios between the optical powers of at least any two optical signals. Preferably, ***said optical switch comprises at least two inputs and two outputs arranged to switch the optical beam path of different wavelength optical signals***, the method comprising misaligning respective optical beam paths so as to achieve a predetermined ratio of output optical power between at least any two of said different wavelength optical signals." Ex. 1006 at 2:66-3:9 (emphases added); *see also id.* at 4:3-14, 6:15-27, 6:50-60.
[1b] one or more other ports for second spectral channels; an output port for an output multi-wavelength optical signal;	Bouevitch discloses one or more other ports for second spectral channels and an output port for an output multi-wavelength optical signal, for the reasons stated in Ground 2, [1b]. *See* Ex. 1016 ¶ 164[1b]. Sparks discloses one or more other ports for second spectral channels and an output port for an output multi-wavelength optical signal. Sparks discloses that "[p]referably, ***the optical switch comprises at least two inputs and two outputs***, and said measurement step comprises determining the relative ratios between the optical powers of at least any two optical signals. Preferably, ***said optical switch comprises at least two inputs and two outputs arranged to switch the optical beam path of different wavelength optical signals***, the method comprising misaligning respective optical beam paths so as to achieve a predetermined ratio of output optical power between at least any two of said different

Claims of the '368 Patent	
	wavelength optical signals." Ex. 1006 at 2:66-3:9 (emphases added); *see also id.* at 4:3-14, 6:15-27, 6:50-60.
[1c] a wavelength-selective device for spatially separating said spectral channels;	Bouevitch discloses a wavelength-selective device for spatially separating said spectral channels, for the reasons stated in Ground 2, [1c]. *See* Ex. 1016 ¶ 164[1c].
[1d] a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port.	Bouevitch discloses a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels and is individually controllable, for the reasons stated in Ground 2, [1d]. Sparks discloses a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port. Sparks discloses that by "***controlling the misalignment of the optical beam path through the switch, the optical signal can be attenuated in a controlled manner***. Utilising an optical switch in this format alleviates the requirement for separate optical attenuators to be incorporated into the system. If the optical system is being used as part of a WDM system, it is typical for the signal to be demultiplexed into the separate optical channels prior to input to the switch. ***If desired, each of the channels passing through the switch may be attenuated to whatever degree necessary to achieve the desired effect, e.g. equalisation of optical power across all channels.*** If the signal is demultiplexed into groups of channels, equalisation of power could also be applied to these groups of wavelengths. ***If desired, normal operation of the switch could be performed with each of the signals attenuated by***

Claims of the '368 Patent	
	misalignment, thus permitting the optical power of any one or more signals to be increased by improving the beam alignment to the degree required to obtain the desired power. " Ex. 1006 at 2:26-44 (emphases added); *see also id.* at 4:9-14; 4:18-22. Sparks discloses that the "***system operates by controlling the movable micromirrors (16,26), which are fabricated using MEMS technology and are capable of two axis movement***, to carefully align the beams so as to ensure that the maximum possible input optical signal is received at the output of the switch. ***The present invention utilises a control system to control the mirrors so as to deliberately misalign the optical beam path 30 through the switch. By non-optimally aligning the optical beam path, the optical beam will be attenuated as it passes through the switch due to a reduction in the power of the beam coupled into the output fibre. This permits the switch to be utilised to achieve any desired optical beam power output less than the maximum.*** Consequently, if desired, WDM system channels may be equalised. Such attenuation is achieved without incorporating separate attenuator(s) within the system." *Id.* at 4:43-58 (emphasis added); *see also id.* at 5:1-11, Fig. 2a and 2b; Ex. 1016 ¶ 164[1d].
[2] The optical add-drop apparatus of claim 1 further comprising a control unit for controlling each of said beam-deflecting elements.	Claim 2 depends from claim 1, which would have been obvious for the reasons discussed above in [1pre] through [1d]. Sparks discloses a control unit for controlling each of said beam-deflecting elements. Sparks discloses that "the switch further comprises control means capable of receiving an input signal indicative of the power of an optical signal, the control means being arranged to control the functioning of said switching means for achieving misalignment of said optical beam path." *Id.* at 3:29-33; *see also id.* at 3:15-22; Ex. 1016 ¶ 164[2].

Claims of the '368 Patent	
[3] The optical add-drop apparatus of claim 2, wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements.	Claim 3 depends from claim 2, which would have been obvious for the reasons discussed above in [2]. Sparks discloses that the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements. Sparks discloses that "[i]n normal operation ***a closed-loop servo control system is employed. This control system is normally used to provide high optical coupling efficiency between the fibres*** and to protect the optical signal against vibration and drift. ***The system operates by controlling the movable micromirrors (16,26), which are fabricated using MEMS technology*** and are capable of two axis movement, to carefully align the beams so as to ensure that the maximum possible input optical signal is received at the output of the switch." *Id.* at 4:39-47 (emphases added); *see id.* at 2:39-65, 4:59-67, 6:2-10, Fig. 4; Ex. 1016 ¶ 164[3].
[4] The optical add-drop apparatus of claim 3, wherein said servo-control assembly maintains said power levels at predetermined values.	Claim 4 depends from claim 3, which would have been obvious for the reasons discussed above in [3]. Sparks discloses that the servo-control assembly maintains power levels at predetermined values, for the reasons stated in claim [3]. *See* Ex. 1016 ¶ 164[4].
[17pre] A method of performing dynamic add and drop in a WDM optical network, comprising	Bouevitch discloses a method of performing dynamic add and drop in a WDM optical network, for the reasons stated in Ground 2, [17pre]. *See* Ex. 1016 ¶ 164[17pre].
[17a] separating an input multi-wavelength optical signal into spectral	Bouevitch discloses separating an input multi-wavelength optical signal into spectral channels, for the reasons stated in Ground 2, [17a]. *See* Ex. 1016 ¶ 164[17a].

Claims of the '368 Patent	
channels;	
[17b] imaging each of said spectral channels onto a corresponding beam-deflecting element; and	Bouevitch imaging each of the spectral channels onto a corresponding beam-deflecting element, for the reasons stated in Ground 2, [17b]. *See* Ex. 1016 ¶ 164[17b].
[17c] controlling dynamically and continuously said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical signal.	Bouevitch and Sparks disclose controlling dynamically and continuously the beam-deflecting elements in two dimensions so as to combine selected ones of the spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into the output multi-wavelength optical signal. Bouevitch discloses dynamically controlling beam-deflecting elements to combine selected spectral channels into an output multi-wavelength optical signal, for the reasons stated in Ground 2, [17c]. Sparks discloses controlling dynamically and continuously the beam-deflecting elements in two dimensions so as to combine selected ones of the spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into the output multi-wavelength optical signal, for the reasons stated in [1d]. *See* Ex. 1016 ¶ 164[17d].
[22] The method of claim 17 further comprising monitoring a power level in one or more of said selected ones of said spectral channels, and controlling an alignment between said input multi-	Claim 22 depends from claim 17, which would have been obvious for the reasons discussed above in [17pre] through [17c]. Sparks discloses monitoring a power level in one or more of the selected ones of the spectral channels, and controlling an alignment between the input multi-wavelength optical signal and corresponding beam-deflecting elements in response to the monitoring, for the reasons stated in claim [3]. *See* Ex. 1016 ¶ 164[22].

Claims of the '368 Patent	
wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring.	

F. Ground 4: Claims 1-6, 9-12 and 15-22 would have been obvious by the combination of Smith and Tew

To the extent the Board determines that Smith does not adequately disclose the "continuously" limitation, claims 1-6, 9-12 and 15-22 of the '368 patent would have been obvious over Smith in view of Tew. Every element of each of these claims is either disclosed or would be an obvious variant on the teachings of these references. Ground 1 is herein incorporated by reference into this section.

Tew is a prior art reference to the '368 patent under § 102(e). Tew claims priority to U.S. Provisional Patent Application No. 60/250,520 ("Tew Provisional") (Ex. 1008) filed November 30, 2000, and the disclosures of Tew and the Tew Provisional are substantially identical. Tew is entitled to a prior art date of the Tew Provisional November 30, 2000 filing, which is before the earliest effective filing date of March 19, 2001 for the '368 patent. The analysis below includes citations to both Tew and the Tew Provisional.

Tew discloses a micromirror wavelength equalizer that allows each

wavelength channel in a wavelength division multiplexed (WDM) system to be individually attenuated. Ex. 1007 at [0017]; Ex. 1008 at 5:1-5. Tew describes analog and digital modes of operating micromirror devices. Ex. 1007 at [0030] & [0031]; Ex. 1008 at 9:10-10:3. Tew explains that in analog mode an "electrode is charged to a voltage corresponding to the desired deflection of the mirror," and depending on the voltage applied "the cone of light reflected by an individual mirror is directed to fall outside the aperture of an optical system, partially within the aperture, or completely within the aperture." Ex. 1007 at [0030]; Ex. 1008 at 9:11-15. Tew states that by contrast in digital mode each micromirror is fully deflected in either of two directions about an axis. Ex. 1007 at [0031]; Ex. 1008 at 9:16-10:3. Tew discloses that analog mode provides fine control over the degree to which the mirrors are rotated. Ex. 1007 at [0059] & [0078]; Ex. 1008 at 18:8-16, 24:1-10; *see* Ex. 1016 at ¶¶ 165-167, Drabik Decl.

To the extent Smith does not fully disclose continuous mirror control, Tew discloses this requirement and it would have been obvious to substitute Tew's analog control into the two-axis mirrors of Smith. Ex. 1016 at ¶¶ 168-170, Drabik Decl. A PHOSITA would have been motivated to combine the teachings of these references at least for the following reasons: (1) continuously controlled mirrors were known to be an alternative to digital mirrors; (2) continuously controlled mirrors allow arbitrary positioning of mirrors and provide more precise control of

reflected signals; and (3) Tew specifically teaches that its analog, continuous micromirrors would be useful for power control applications in WDM systems. Ex. 1007 at [0017] & [0030]; Ex. 1008 at 5:1-5, 9:11-15.

In addition, analog (continuous) control of the mirrors would be obvious to try because there are only two general options for such control—either analog (continuous) or digital control. Ex. 1007 at [0030] & [0031]; Ex. 1008 at 9:10-10:3. For example, Tew discusses analog control as the alternative to digital control of mirrors to increase the precision of the rotation of the micromirrors. Ex. 1007 at [0059] & [0078]; Ex. 1008 at 18:8-16, 24:1-10. With only two options, both of which were known in the prior art, and both of which were suggested as working solutions for control, a PHOSITA would have expected that analog control would work well with the two axis mirrors of Smith. Ex. 1016 at ¶ 171.

G. Ground 5: Claims 1, 2, 5, 6, 9-12 and 15-21 would have been obvious by the combination of Bouevitch, Carr and Tew

To the extent the Board determines that Bouevitch and Carr do not adequately disclose the "continuously" limitation, claims 1, 2, 5, 6, 9-12 and 15-21 of the '368 patent would have been obvious over Bouevitch in view of Carr and Tew. Every element of each of these claims is either disclosed or would be an obvious variant on the teachings of these references. Ex. 1016 at ¶ 172. Grounds 2 and 4 are herein incorporated by reference into this section.

H. Ground 6: Claims 1-4, 17 and 22 would have been obvious by the combination of Bouevitch, Sparks and Tew

To the extent the Board determines that Bouevitch and Sparks do not adequately disclose the "continuously" limitation, claims 1-4, 17 and 22 of the '368 patent would have been obvious over Bouevitch in view of Sparks and Tew. Every element of each of these claims is either disclosed or would be an obvious variant on the teachings of these references. Ex. 1016 at ¶ 173. Grounds 3 and 4 are herein incorporated by reference into this section.

VIII. CONCLUSION

As set forth above, and as supported by the expert testimony of Dr. Timothy J. Drabik, the Petitioned Claims would have been obvious in view of the prior art cited herein. Petitioner has established a reasonable likelihood of prevailing on each ground and respectfully requests institution of an *inter partes* review.

Respectfully submitted,
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Attachment A:

CERTIFICATE OF SERVICE ON PATENT OWNER UNDER 37 C.F.R. §§ 42.6(e) and 42.105

Under 35 U.S.C. §§ 311-319 and 37 C.F.R. §§ 42.1-.80 and 42.100-.123, the undersigned certifies that on February 12, 2015, a complete and entire copy of this Petition for *Inter Partes* Review of U.S. Patent No. RE42,368 and all supporting exhibits, attachments, and a power of attorney were served via EXPRESS MAIL®, postage prepaid, to the Patent Owner by serving the following parties:

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Attachment B: Appendix of Exhibits

Exhibit	Description
Ex. 1001	U.S. Patent No. RE42,368 to Chen et al.
Ex. 1002	U.S. Patent No. 6,498,872 to Bouevitch et al.
Ex. 1003	Prosecution History for U.S. Patent No. RE42,368.
Ex. 1004	Joseph E. Ford et al., *Wavelength Add-Drop Switching Using Tilting Micromirrors*, 17(5) Journal of Lightwave Technology 904 (1999).
Ex. 1005	U.S. Patent No. 6,442,307 to Carr et al.
Ex. 1006	U.S. Patent No. 6,625,340 to Sparks et al.
Ex. 1007	U.S. Patent Publication No. 2002/0081070 to Tew.
Ex. 1008	U.S. Provisional Patent Application No. 60/250,520 to Tew.
Ex. 1009	U.S. Patent No. 6,798,941 to Smith et al.
Ex. 1010	U.S. Provisional Patent Application No. 60/234,683 to Smith et al.
Ex. 1011	J. Alda, "Laser and Gaussian Beam Propagation and Transformation," in *Encyclopedia of Optical Engineering*, R. G. Driggers, Ed. Marcel Dekker, 2003, pp. 999–1013. ("Alda")
Ex. 1012	Joint Claim Construction and Prehearing Statement, Capella Litigation, Case No. 3:14-cv-03348-EMC, Dkt. 151.
Ex. 1013	Newton's Telecom Dictionary (17th ed. 2001) (excerpted).
Ex. 1014	Fiber Optics Standard Dictionary (3rd ed. 1997) (excerpted).
Ex. 1015	Webster's New World College Dictionary (3rd ed. 1997) (excerpted).
Ex. 1016	Declaration of Dr. Timothy Drabik.
Ex. 1017	Curriculum Vitae of Dr. Timothy Drabik.

Ex. 1018	U.S. Patent No. 6,253,001 to Hoen.
Ex. 1019	U.S. Patent No. 6,567,574 to Ma et al.
Ex. 1020	U.S. Patent No. 6,256,430 to Jin et al.
Ex. 1021	U.S. Patent No. 6,631,222 to Wagener et al.
Ex. 1022	U.S. Patent No. 5,414,540 to Patel et al.
Ex. 1023	U.S. Patent Publication No. 2002/0097956.
Ex. 1024	Shigeru Kawai, Handbook of Optical Interconnects (2005) (excerpted).
Ex. 1025	U.S. Patent No. 6,798,992 to Bishop et al.
Ex. 1026	Joseph W. Goodman, Introduction to Fourier Optics, Second Edition, McGraw-Hill (1996).
Ex. 1027	U.S. Patent No. 6,204,946 to Aksyuk et al.
Ex. 1028	L.Y. Lin, "Free-Space Micromachined Optical Switches for Optical Networking, *IEEE Journal of Selected Topics In Quantum Electronics*," Vol. 5, No. 1, pp. 4–9, Jan./Feb. 1999.
Ex. 1029	S.-S. Lee, "Surface-Micromachined Free-Space Fiber Optic Switches With Integrated Microactuators for Optical Fiber Communications Systems," in *Tech. Dig. 1997 International Conference on Solid-State Sensors and Actuators*, Chicago, June 16-19, 1997, pp. 85–88.
Ex. 1030	H. Laor, "Construction and performance of a 576×576 single-stage OXC," in *Tech. Dig. LEOS '99* (vol. 2), Nov. 8–11, 1999, pp. 481–482.
Ex. 1031	R. Ryf, "1296-port MEMS Transparent Optical Crossconnect with 2.07 Petabit/s Switch Capacity," in *Tech. Dig. OSA Conference on Optical Fiber Communication*, March 2001, pp. PD28-1–PD28-3.
Ex. 1032	A. Husain, "MEMS-Based Photonic Switching in Communications Networks," in *Tech. Dig. OSA Conference on Optical Fiber Communication*, 2001, pp. WX1-1–WX1-3.
Ex. 1033	U.S. Patent No. 5,661,591 to Lin et al.

Ex. 1034	H. Laor et al., "Performance of a 576×576 Optical Cross Connect," *Proc. of the Nat'l Fiber Optic Engineers Conference*, Sept. 26-30, 1999.
Ex. 1035	V. Dhillon. (2012, Sep. 18). *Blazes and Grisms*. Available: http://www.vikdhillon.staff.shef.ac.uk/teaching/phy217/instruments/phy217_inst_blaze.html. ("Dhillon")
Ex. 1036	Fianium Ltd. *WhiteLase SC480 New Product Data Sheet*. Available: http://www.fianium.com/pdf/WhiteLase_SC480_BrightLase_v1.pdf. ("Fianium")